The effect of gradual weaning on haematological profiles and leukocyte relative gene expression levels of Holstein-Friesian and Jersey bull calves

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Introduction

- Haematological profiles and leukocyte gene expression levels are influenced by the stress response generated due to abrupt weaning in suckler calves (O'Loughlin *et al*., 2011).
- **Objectives**: **(i)** to examine the effect of **breed** and **plane of nutrition**, on **haematological profiles** and

  (ii) to examine the effect of **breed,** on **leukocyte gene expression,**

  in artificially reared Holstein-Friesian and Jersey calves in response to gradual weaning.

Material and Methods

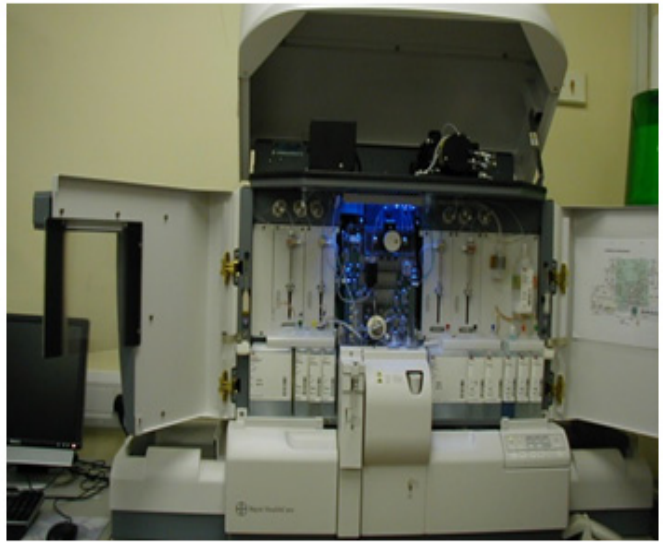
- Spring 2013 - study conducted at Teagasc Grange.
- **Purebred Holstein-Friesian (H-F)** (N = 44) and **Jersey (J)** (N = 29) bull calves (age = 27 days ± 9) were blocked, within breed, on the basis of live-weight, age and sire to one of three planes of nutrition.
- Calves were offered milk-replacer and concentrate using an electronic feeding system (Forster-Tecknik SA 2000, Engen, Germany).
- Calves were offered a token quantity of chopped straw during the peri-weaning period.

Calf breed	Volume and quantity of milk replacer	Concentrates	Target average daily gain to weaning
H-F 	**8.0 L** (1200g)	*Ad libitum*	**1000g**
H-F 	**6.0 L** (800g)	Max 1.5kg	**700g**
H-F 	**4.0 L** (500g)	Max 1.0kg	**500g**
J 	**6.0 L** (800g)	*Ad libitum*	**700g**
J 	**4.0 L** (500g)	Max 1.5kg	**500g**
J 	**3.5 L** (350g)	Max 1.0kg	**300g**

- Weaning - calves consuming 1kg of concentrate/day for 3 days.
- **After weaning**, concentrate allowances were adjusted.

Plane of Nutrition	Holstein-Friesian 	Jersey 
High	*Ad libitum*	*Ad libitum*
Medium	2kg	1.7kg
Low	1.7kg	1.4kg

- On d -14, -6, -3, 0, 1, 3, 8, and 14 relative to weaning (d 0), all calves were blood sampled for subsequent haematological analysis using an ADVIA 2120 analyser.
- Blood was collected on d -14, 1, and 8 for relative gene expression studies.
- Data were analysed using repeated measures mixed models ANOVA (MIXED procedure of SAS v 9.3).



Results: Mean daily energy intake

		UFL pre-weaning	UFL post-weaning	UFL (d -13 to d 14)
Breed	HF	1.97[a]	2.35	2.16
	J	1.72[b]	2.08	1.98
	se	**0.04**	**0.11**	**0.07**
Feed level	High	2.27[a]	3.56[a]	2.85[a]
	Med	1.80[b]	1.68[b]	1.87[b]
	Low	1.47[c]	1.41[b]	1.50[c]
	se	**0.05**	**0.14**	**0.08**
P values	Breed	<.001	0.10	0.07
	Feed	<.0001	<.0001	<.0001
	B x F	**0.50**	**1.00**	**0.64**

[a,b] Within a column, means not having a common superscript differ significantly ($P < 0.05$). Data were analysed using SAS/STAT 9.3 (SAS Inst. Inc., Cary, NC, USA). The differences between means were tested using the Tukey-Kramer test for multiple comparisons.

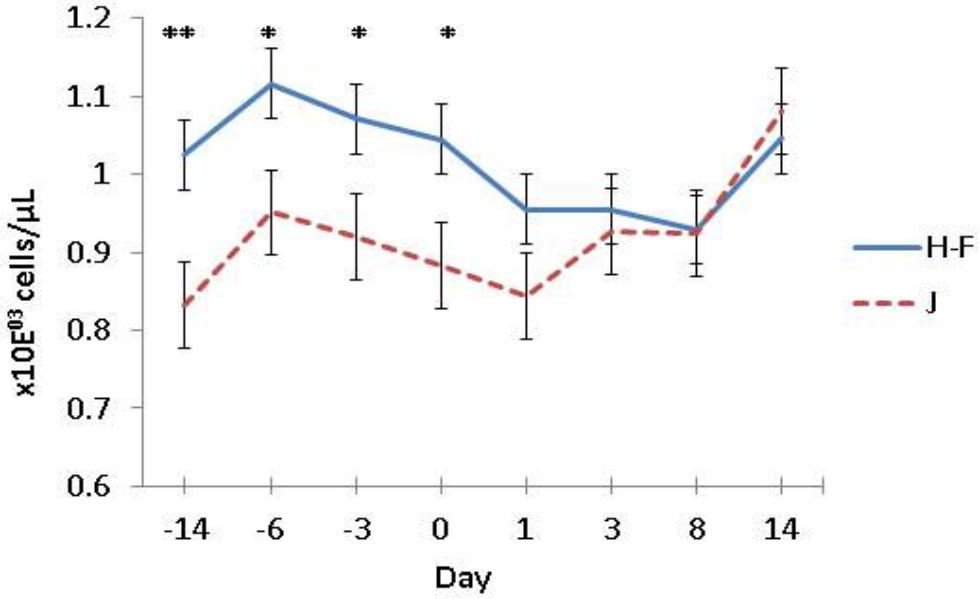
Results: Average Daily Gain

		ADG pre-weaning	ADG post-weaning	ADG from d -13 to d 14
Breed	HF	0.68[a]	0.95[a]	0.88[a]
	J	0.60[b]	0.68[b]	0.67[b]
	se	**0.02**	**0.04**	**0.03**
Feed level	High	0.71[a]	0.97[a]	0.86[a]
	Med	0.62[b]	0.75[b]	0.78[a]
	Low	0.59[b]	0.71[b]	0.68[b]
	se	**0.03**	**0.05**	**0.04**
P values	Breed	0.01	<.0001	<.0001
	Feed	0.02	<.01	0.01
	B x F	**0.73**	**0.96**	**0.31**

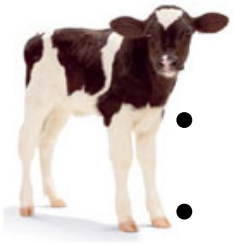
[a,b] Within a column, means not having a common superscript differ significantly ($P < 0.05$). Data were analysed using SAS/STAT 9.3 (SAS Inst. Inc., Cary, NC, USA). The differences between means were tested using the Tukey-Kramer test for multiple comparisons.

Monocyte Number

- Breed × time interactions were observed (P < 0.01).
- Monocyte number differed initially and throughout the weaning period.
- Monocyte number converged between the breeds from d 1 post-weaning.

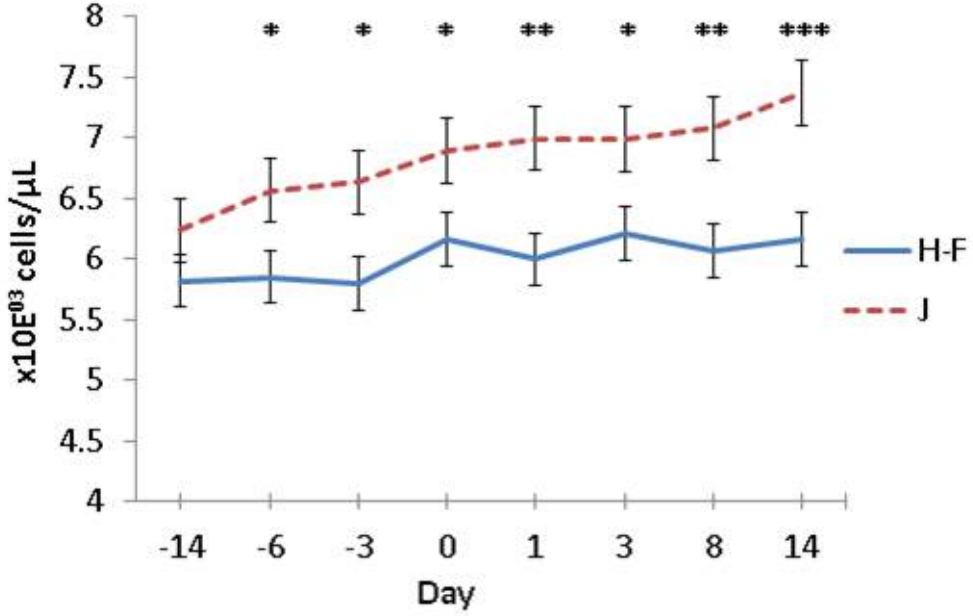


*P ≤ 0.05, ** P ≤ 0.01.



Lymphocyte Number

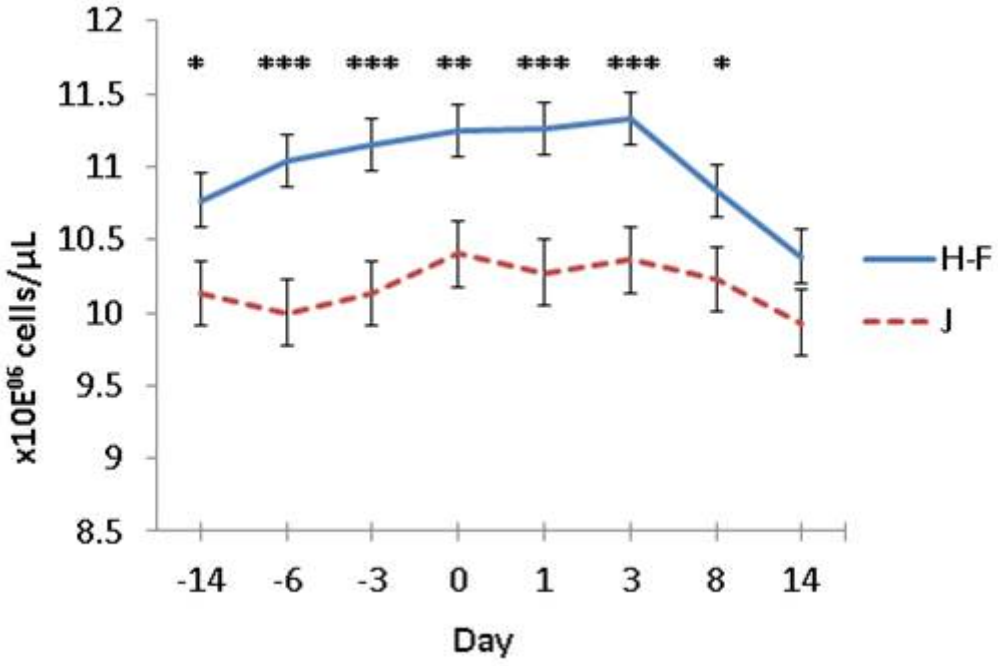
- Breed × time interactions were observed (P < 0.01).
- The breeds did not initially differ.
- Following the onset of gradual weaning J calves had a greater number of lymphocytes throughout both the weaning and post-weaning periods



*P ≤ 0.05, ** P ≤ 0.01, *** P ≤ 0.001.

Red Blood Cell (RBC) Number

- Breed × time interactions were observed (P < 0.05).
- H-F calves had greater RBC numbers up to d 8 post-weaning.
- There was no difference at d 14 between breeds.



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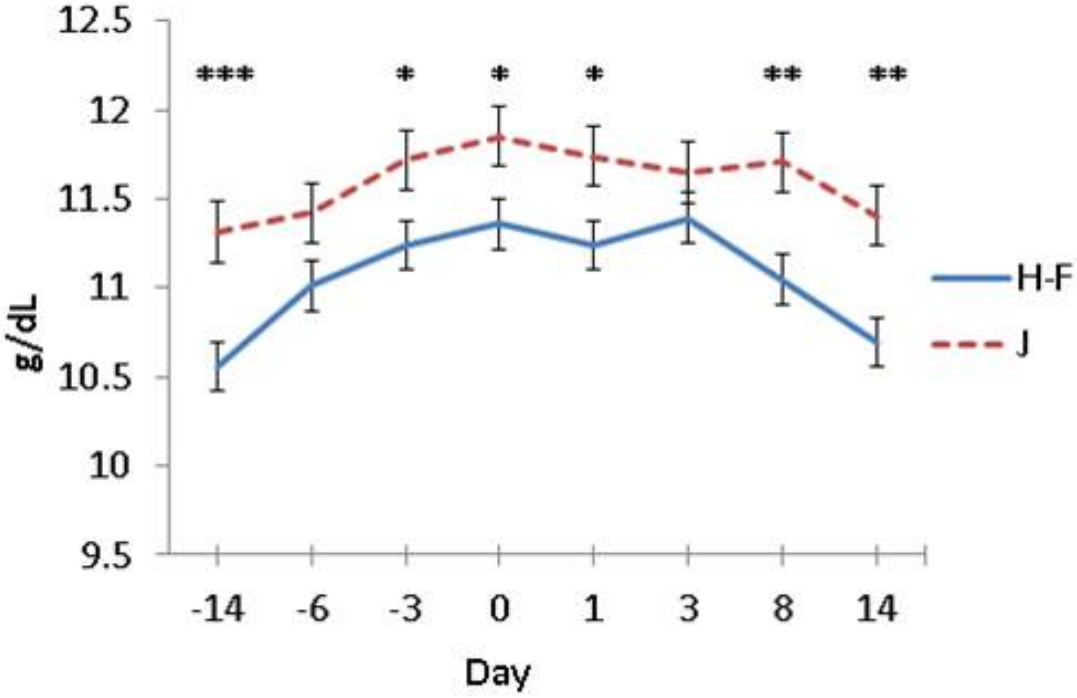
Haemoglobin

- Breed × time interactions were observed (P < 0.05).
- J calves had greater concentrations of haemoglobin, except on d -6 and d 6.



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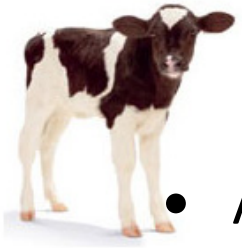
Haematological Results

- There were no breed × plane of nutrition interactions ($P > 0.05$) observed.
- Neutrophil number was greater in Holstein-Friesian compared to Jersey calves ($P \leq 0.05$).
- Haematocrit percentage was greater in J compared with H-F calves ($P \leq 0.05$)
- Plane of nutrition did not affect haematological profiles ($P > 0.05$).



Leukocyte Relative Gene Expression

- A subset of calves from each breed consuming 6 l MR were randomly selected for gene expression profiling.
- Blood samples were collected on d -14, 1, and 8, relative to weaning.
- Real-time qPCR was used to measure gene expression of ***CXCL8, GRα, Fas, TLR4*** and ***TNFα***.

Gene Expression Results

- No effect of breed on average daily gain.
- No breed × sampling time interaction for any immunological genes (P > 0.05).
- Relative gene expression levels were higher (P ≤ 0.05) in J calves for *CXCL8* (fig 1) and *GRα* (fig 2).

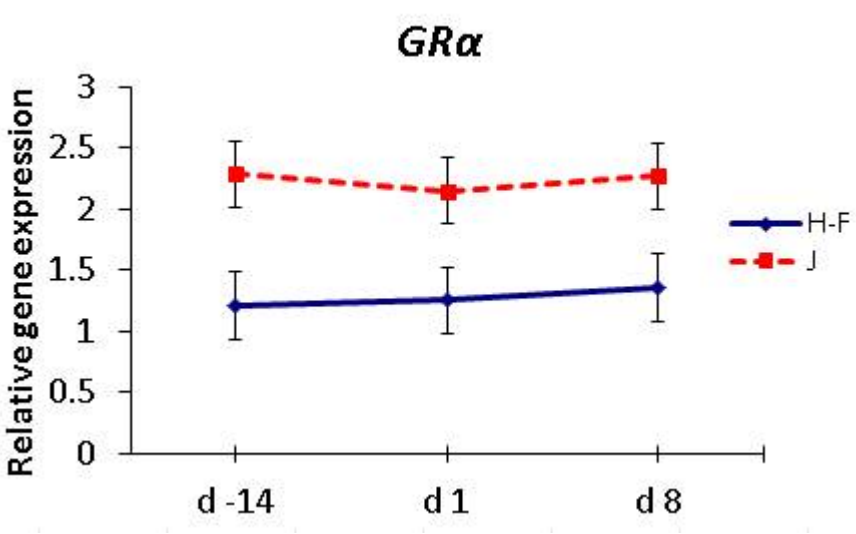


Fig. 1. Effect of breed on expression of *GRα.*

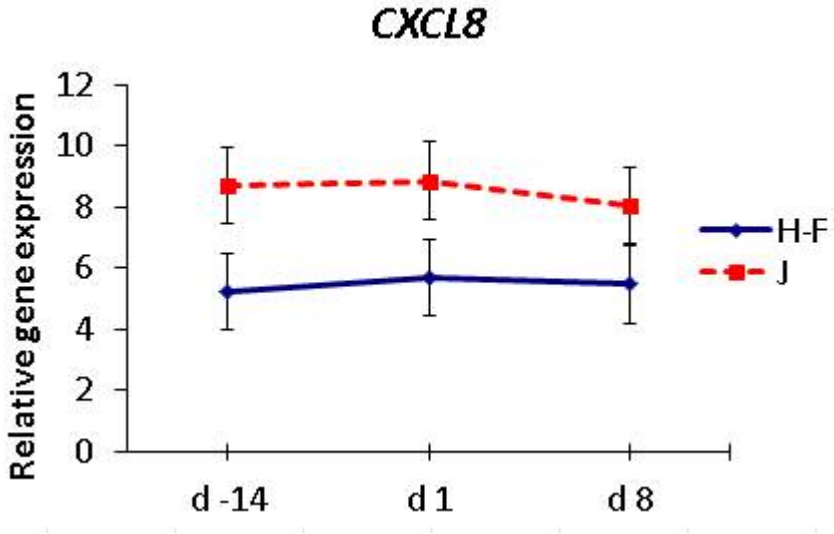
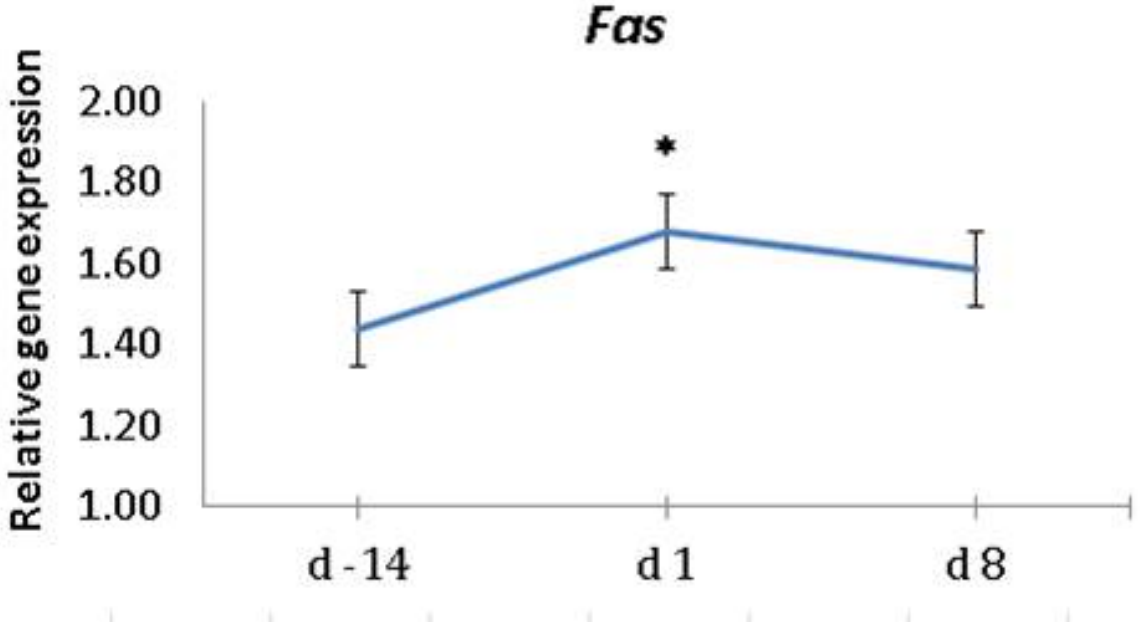


Fig. 2. Effect of breed on expression of *CXCL8*

Gene Expression Results

Relative gene expression of *Fas* increased between d -14 and d 1 and decreased between d 1 and d 8



*P ≤ 0.05.

Conclusion

- The haematological profiles suggest a differential biological response to gradual weaning between Holstein Friesian and Jersey calves.
- Plane of nutrition had no effect on haematological profiles.
- An immune response to gradual weaning was observed as *Fas* expression changed over time.
- Increased levels of transcripts for *CXCL8* and *GRα* suggests that Jersey calves may have a more sensitive immune system.



Acknowledgements

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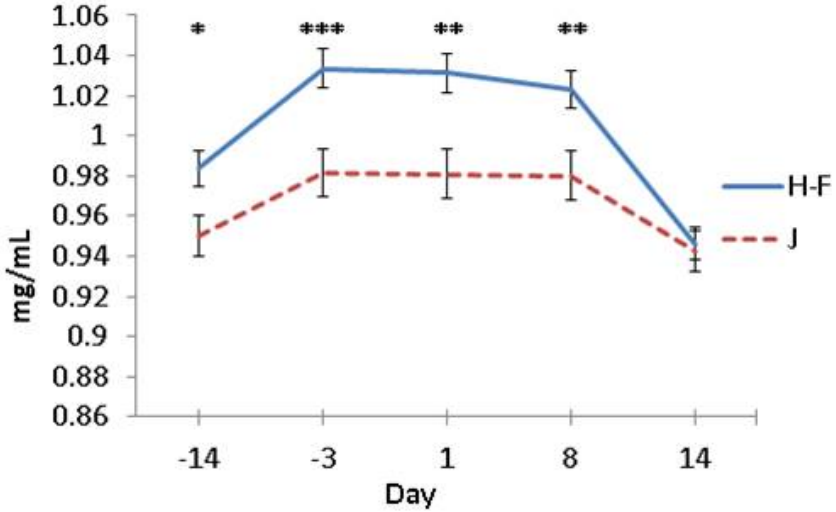
Acute Phase Protein: Haptoglobin

- Haptoglobin concentration was measured using an automatic analyser (Olympus AU 400 Analyser) and a commercial assay kit (Tridelta Development Ltd)
- Breed × time interactions were observed ($P < 0.05$).
- H-F calves had greater plasma haptoglobin concentrations up until d 8 post-weaning.



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